SYSTEM AND METHOD FOR USE OF METADATA IN PRINT JOB INTERRUPTION MANAGEMENT

FIELD OF THE INVENTION

The present invention is directed generally to a method for printing documents and specifically to an improved method for prioritizing and distributing documents to a plurality of printers based on the documents' printing requirements.

BACKGROUND OF THE INVENTION

The need to perform basic administrative duties as quickly as possible drives the need for tools that improve office productivity. In many offices, one major bottleneck that workers face is the printer. When printer resources are limited, the ability to maximize printer productivity is critical to improving efficiency. However, as the quality of documents increases with more specialized fonts, enhanced color graphics, and new document macros, the print jobs in the print queues are becoming larger causing the print queues to become longer. Moreover, as documents become more specialized, the ability of a single printer to handle the entire document decreases. Therefore, a need exists for a method for printing a single print job correctly and efficiently.

The prior art method of printing a complex print job is to send the entire document to a single printer. If the printer already has a print queue with numerous print jobs, the print time for the last queued document can be extensive. This problem is further compounded when one or more of the pages of the document contain color based graphics in encapsulated post-script format, complex macros, sophisticated fonts, and/or embedded graphics. These specialized document images may not be printed properly if the printer receiving the job does not have the required capabilities. For example, if a document containing pages with color text or images is

queued to a black and white printer, then the desired effect of the colors in the document is lost. Additionally, the text may not be processed properly if a specific printer is not postscript and/or graphic capable. In another example, documents containing digital photographs may not be acceptable if the photographic images are not printed on photographic paper. Therefore, a need exists for a method of printing a complex document on a plurality of normal and specialty printers.

The prior art has addressed the problem of print manager control of multiple printers. For example, United States Patent 5,327,526 (the '526 patent) entitled "Print Job Control System" discloses a method of printing a plurality of documents in which the documents are printed according to a predefined priority indicator. The method disclosed in the '526 patent continuously manipulates the order of the documents to insure that the highest priority documents are printed before the lower priority jobs. However, the '526 patent does not disclose a method of dividing documents based on the characteristics of the documents nor a method for dividing documents among a plurality of printers. The '526 patent also does not disclose a method for interrupting the printing when a document needs to be printed immediately. Therefore, a need exists for a method of separating a document and sending the document to a plurality of printers. A need also exists for a method for prioritizing documents and interrupting the printing of a document when a high priority document needs to be printed immediately.

United States Patent 5,547,178 (the '178 patent) entitled "Printer Mailbox Split Jobs Overflow Banner Sheet Indicator System" discloses a job splitting program. The method of the '178 patent breaks the print job into multiple print jobs when the print jobs exceed the maximum capacity of the sorting bin in the copier. However, the '178 patent is limited to separating print jobs based on *external* characteristics (the copier bin capacity). The '178 patent does not

disclose a method of separating print jobs based on the *internal* document characteristic, that is the characteristics of the document to be printed. The '178 patent also does not disclose a method for dividing a print job among a plurality of printers. Therefore, a need exists for a method of separating a print job based on document characteristics and sending the document to a plurality of printers.

United States Patent 5,859,711 (the '711 patent) entitled "Multiple Print Engine with Virtual Job Routing" discloses a method for distributing a print job to multiple printers. The method disclosed in the '711 patent sends the print jobs to multiple print engines and then reassembles the document. However, the '711 patent does not disclose an orderly method for separating the document and selecting the printers based on the time required to print each print job. Therefore, a need exists in the art for a method of separating a print job based on the printing needs of the document and sending the document to a plurality of printers based on the time to print a section of the document at each of the plurality of printers.

Consequently, a need exists in the art for a method and apparatus for analyzing a document and separating the document based on the internal document characteristics. Furthermore, a need exists in the art for a method of sending the separated document to a plurality of printers. Additionally, a need exists in the art for a method of determining the most efficient routing method for a document based on the print queue of a plurality of printers and the specific document characteristics. Finally, a need exists in the art for a method to prioritize a plurality of documents in a print queue and to interrupt the printing of another document when necessary in a multiple printer environment.

SUMMARY OF THE INVENTION

The present invention, which meets the needs stated above, is a methodology for prioritizing a plurality of documents, separating a document, sending the document pages to a plurality of different printers based on the document page characteristics, and reassembling the document. The software embodiment of the present invention comprises a Prioritization Program (PP), a Classification Program (CP), a Specific Printer Program (SPP), a Color Printer Program (CPP), and a Black/White Printer Program (B/WPP). The PP prioritizes the documents when there are a plurality of documents waiting to be printed. The PP can interrupt the CP when a high priority document needs to be printed. The CP analyzes the metadata in each page of the document to determine if the page should be sent to a specific printer, a color printer, or a black/white printer. The CP separates the document, places each page in a holding queue for the appropriate printer, and runs the SPP, CPP, and B/WPP.

The SPP compiles the pages from the specific printer holding queue to form a print job, compares the print job to a specific printer page threshold, and separates the print job into a plurality of print jobs if necessary. The SPP also analyzes the available specific printers to determine the specific printer with the shortest wait time and sends the print job to the appropriate printer. The CPP compiles the pages from the color printer holding queue to form a print job, compares the print job to a color printer page threshold, and separates the print job into a plurality of print jobs if necessary. The CPP also analyzes the available color printers to determine the color printer with the shortest wait time and sends the print job to the appropriate printer. The B/WPP compiles the pages from the black/white printer holding queue to form a print job, compares the print job to a black/white printer page threshold, and separates the print job into a plurality of print jobs if necessary. The B/WPP also analyzes the available black/white

printers to determine the black/white printer with the shortest wait time and sends the print job to the appropriate printer. The document may then be reassembled from the various printers to produce a finished document which was printed in considerably less time than the prior art printing methods.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is an illustration of a computer network used to implement the present invention;

FIG. 2 is an illustration of a computer memory and processor associated with the present invention;

FIG. 3 is an illustration of the Prioritization Program (PP) of the present invention;

FIG. 4 is an illustration of the Classification Program (CP) of the present invention;

FIG. 5 is an illustration of the Specific Printer Program (SPP) of the present invention;

FIG. 6 is an illustration of the Color Printer Program (CPP) of the present invention;

FIG. 7 is an illustration of the Black/White Printer Program (B/WPP) of the present invention; and

FIG. 8 is an illustration of the process of printing a document utilizing the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As used herein, the term "computer" shall mean a machine having a processor, a memory, and an operating system, capable of interaction with a user or other computer, and shall include without limitation desktop computers, notebook computers, personal digital assistants (PDAs), servers, handheld computers, and similar devices.

As used herein, the term "document" means a computer file comprising two or more pages which a user wants to print.

As used herein, the term "interrupt" means to suspend the printing action of another document and begin processing and printing a higher priority document.

As used herein, the term "metadata" means hidden data in a document describing printable document data. For example, a file header embedded within a document that states that a document contains color graphics, color effects, macros, a specific font, or other specific requirements is metadata. Persons skilled in the art are aware of other types of metadata.

As used herein, the term "print farm profile" means data for at least one printer including the number, size, type, and other properties of print jobs in the print queue for the printer, the printer speed, amount of paper in the printer bin, and other properties concerning the printer.

As used herein, the term "print job" means a document which has been allocated to a printer for printing. The separated pages of a document are sent to a holding queue until the document is fully separated, at which point the pages in the holding queue are compiled into a single print job. A print job may be further separated into two or more print jobs if the print job exceeds a printer page threshold.

As used herein, the term "separate" means to divide the pages of a document or print job into two or more print jobs. Documents are only separated at the page boundaries; individual document pages cannot be separated.

FIG. 1 is an illustration of computer network **80** associated with the present invention. Computer network **80** comprises local machine **85** electrically coupled to network **86**. Local machine **85** is electrically coupled to remote machine **84** and remote machine **83** via network **86**. Local machine **85** is also electrically coupled to server **81** and database **82** via network **86**. Network **86** may be a simplified network connection such as a local area network (LAN) or may be a larger network such as a wide area network (WAN) or the Internet. Furthermore, computer network **80** depicted in FIG. 1 is intended as a representation of a possible operating network that may contain the present invention and is not meant as an architectural limitation.

The internal configuration of a computer, including connection and orientation of the processor, memory, and input/output devices, is well known in the art. The present invention is a methodology that can be embodied in a computer program. Referring to FIG. 2, the methodology of the present invention is implemented on software by Prioritization Program (PP) **150**. PP **150** includes Classification Program (CP) **200**, Specific Printer Program (SPP) **300**, Color Printer Program (CPP) **400**, and Black/White Printer Program (B/WPP) **500**. PP **150**, CP **200**, SPP **300**, CPP **400**, and B/WPP **500** described herein can be stored within the memory of any computer depicted in FIG. 1. Alternatively, PP **150**, CP **200**, SPP **300**, CPP **400**, and B/WPP **500** can be stored in an external storage device such as a removable disk, a CD-ROM, or a USB storage device. Memory **100** is illustrative of the memory within one of the computers of FIG. 1. Memory **100** also contains print farm profile **102**. The present invention may interface with print farm profile **102** through memory **100**. As part of the present invention, the memory **100** can be configured with PP **150**, CP **200**, SPP **300**, CPP **400**, and/or B/WPP **500**. Processor **106** can execute the instructions contained in PP **150**, CP **200**, SPP **300**, CPP **400**, and/or B/WPP **500**.

In alternative embodiments, PP **150**, CP **200**, SPP **300**, CPP **400**, and/or B/WPP **500** can be stored in the memory of other computers. Storing PP **150**, CP **200**, SPP **300**, CPP **400**, and/or B/WPP **500** in the memory of other computers allows the processor workload to be distributed across a plurality of processors instead of a single processor. Further configurations of PP **150**, CP **200**, SPP **300**, CPP **400**, and/or B/WPP **500** across various memories are known by persons of ordinary skill in the art.

As part of the present invention, a user can assign a priority to a document that is sent to the print manager of the present invention. In other words, a user may assign high priority to a document that needs to be printed immediately, a medium priority to documents that need to be printed promptly, but not in front of high priority documents, and low priority to documents that can be printed after all of the medium and high priority documents have been printed. The priority data is stored in the document metadata. PP **150**, illustrated in FIG. 3, uses the priority data to prioritize the printing order for the documents. PP **150** is most useful when a plurality of users are sending a plurality of documents to the print manager of the present invention. Specifically, if the users are sending the documents to the present invention at a much higher rate than the invention can print out the documents, PP **150** separates the more important documents from the lesser important documents and insures that the more important documents print first.

Turning to FIG. 3, the logic of Prioritization Program (PP) **150** is illustrated. PP **150** is a methodology for prioritizing the documents when there are a plurality of documents waiting to be printed. PP **150** can also interrupt any currently printing documents when a high priority document is received. PP **150** starts (**152**) when the user sends a document to be printed. PP **150** receives the document to be printed (**154**). PP **150** sends an acknowledgement back to the computer that originated the document (**156**). PP **150** then places the document at the end of the

priority holding queue (**158**). PP **150** then analyzes all of the documents in the holding queue, determining the user-assigned priority of each document (**160**). PP **150** then determines if there are any high priority documents (**162**). If there are not any high priority documents, PP **150** proceeds to step **166**. If there are any high priority documents, PP **150** sends the earliest high priority document to CP **200** with an interruption instruction (**164**), then proceeds to step **174**.

The interruption instruction instructs CP **200** to suspend the printing of the document that CP **200** is currently printing. The interruption instruction also instructs CP **200** to immediately print the high priority document, and then resume printing the suspended document. CP **200** will comply with the interruption instruction unless CP **200** is already printing a high priority document. In that case, CP **200** finishes printing the high priority document that CP **200** is currently printing. CP **200** then prints the high priority document that contained the interruption instruction.

Returning to step **166**, PP **150** determines if there are any medium priority documents (**166**). If there are not any medium priority documents, PP **150** proceeds to step **170**. If there are any medium priority documents, PP **150** sends the earliest medium priority document to CP **200** (**168**), then proceeds to step **174**. Returning to step **170**, PP **150** determines if there are any low priority documents (**170**). If there are not any low priority documents, PP **150** proceeds to step **176**. If there are any low priority documents, PP **150** sends the earliest low priority document to CP **200** (**172**), then proceeds to step **174**.

At step **174**, PP **150** runs CP **200** (**174**). PP **150** then makes a determination whether there are any documents remaining in the priority holding queue (**176**). If there are documents remaining in the priority holding queue, then PP **150** returns to step **160**. If there are not any documents remaining in the priority holding queue, then PP **150** ends (**178**).

Turning to FIG. 4, the logic of Classification Program (CP) **200** is illustrated. CP **200** is a methodology for separating a document into the pages that contain color graphics, black and white text, or other features suitable for a specific printer. The separation of the document that occurs in CP **200** may optionally be combined with the separation of print jobs that is described in SPP **300**, CPP **400**, and B/WPP **500**. CP **200** starts (**202**) when instructed by PP **150**. CP **200** receives the document to be printed (**204**). If the received document is a high priority document and contains an interruption instruction, then CP **200** suspends any current processing and immediately begins processing the high priority document. CP **200** also instructs SPP **300**, CPP **400**, and B/WPP **500** to suspend printing the current document and begin printing the high priority document that CP **200** is processing. As used in reference to CP **200**, processing means performing the steps depicted in FIG. 4.

CP **200** then analyzes the first page of the document (**208**). In analyzing the first page of the document, CP **200** examines the metadata for the first page of the document to determine if the first page of the document contains any color graphics or effects. CP **200** also analyzes the document metadata to determine if the first page contains any fonts, digital photographs, graphics, or other effects that require a specific printer to print the page. Examples of specific printers are printers containing letterhead, photographic printers, and any other printer which is enabled to print fonts or images unprintable by other printers. The document metadata may include any of the following data about the document: document size, document type, text type, text color, graphic type, graphic color, priority of print job, page size, page format characteristics, and/or document resolution requirements. Alternatively, the document metadata may specifically direct a page to a specific printer without indicating the reasons why the page is to be printed on a specific printer. An example of a specific printer direction is directing one or

more pages of the document to the closest printer to the user's computer or a printer at a specific location.

CP **200** then makes a determination whether the metadata for the current page specifies a specific printer (**210**). If the metadata specifies a specific printer for the current page, then CP **200** places the current page in a holding queue for the specific printer (**212**) and proceeds to step **220**. There may possibly be a plurality of specific printer holding queues as some pages may require one type of specific printer while other pages require a different type of specific printer. The holding queue for the specific printer may be in any memory defined by a person of ordinary skill in the art such as cache memory. If at step **210** the metadata for the current page does not specify a specific printer, then CP **200** proceeds to step **214**.

At step **214**, CP **200** then makes a determination whether the metadata for the current page indicates that there are color effects, graphics, or any other need for a color printer in the current page (**214**). If the metadata indicates the need for a color printer for the current page, then CP **200** places the current page in a holding queue for the color printer (**216**) and proceeds to step **220**. The holding queue for the color printer may be in any memory defined by a person of ordinary skill in the art such as cache memory. If at step **214** the metadata for the current page does not indicate the need for a color printer, then CP **200** places the page in a holding queue for a black and white printer (**218**), and proceeds to step **220**. The holding queue for the black/white printer may be in any memory defined by a person of ordinary skill in the art such as cache memory.

At step **220** CP **200** determines if there any pages remaining (**220**). If there are pages remaining, then CP **200** analyzes the next page in the document (**222**) similar to the analysis in step **208**. CP **200** then returns to step **210**. Returning to step **220**, if CP **200** determines that

there are not any pages remaining, then CP **200** runs SPP **300** (**224**), runs CPP **400** (**226**), runs B/WPP **500** (**228**), and ends (**230**).

Turning to FIG. 5, the logic of Specific Printer Program (SPP) **300** is illustrated. SPP **300** is a methodology for printing the document pages that are stored in the specific printer holding queue. A document may request a specific printer if the document contains special sophisticated fonts, embedded graphics, or requires very high resolution. Specific printers may also contain a specific paper such as photographic quality (glossy) paper, perforated pages, or company letterhead. Specific printers may also be designated by the user, such as "the printer in room 2036." SPP **300** starts (**302**) when requested by CP **200**. SPP **300** then accepts a user definition of a specific printer page threshold (**304**). The specific printer page threshold is the maximum number of pages to be printed as a single print job on any one printer. If the print job exceeds the specific printer page threshold, then the print job will be separated into a plurality of smaller print jobs. The specific printer page threshold can be stored in memory so that the user does not have to enter a new specific printer page threshold upon every use of the present invention. Alternatively to accepting a user defined specific printer page threshold, SPP **300** can automatically select a specific printer page threshold by a method determined by persons of ordinary skill in the art.

Next, SPP **300** acquires the number of pages from the holding queue for the specific printer (**306**). SPP **300** compiles these pages into a single print job for the specific printer. If there is a plurality of specific printer holding queues, then SPP **300** creates a print job for each holding queue and repeats the method described herein for each type of specific printer required. SPP **300** then makes a determination whether the number of pages in the current print job is greater than the specific printer page threshold (**308**). If the number of pages in the current print

job is greater than the specific printer page threshold, then SPP **300** separates the print job (**310**) and returns to step **308**. In separating the print job, SPP **300** may divide the print job into two even-sized print jobs. Alternatively, SPP **300** may extract a series of print jobs each less than the specific printer page threshold from the original print job until there are no print jobs exceeding the specific printer page threshold. Persons of ordinary skill in the art are aware of other methods for separating a print job. If at step **308** SPP **300** determines that the number of pages is not greater than the specific printer page threshold, then SPP **300** proceeds to step **312**.

At step **312**, SPP **300** determines the appropriate printer for the print job(s) (**312**). In order to determine the appropriate printer, SPP **300** analyzes the print farm profile **314** obtained from memory. Print farm profile **314** may be the print farm profile for only the specific printers or may be a print farm profile for all printers such as print farm profile **102** in FIG. 2. It is likely that there may be a plurality of specific printers and that SPP **300** will have to choose the most appropriate printer(s) for the print job(s) from the available printers. SPP **300** determines the appropriate printer by analyzing the number and size of print jobs queued for each specific printer. SPP **300** calculates the print time for each document in the print queue by dividing the size of each print job by the printer speed For example, if a forty page document is printing on a twenty page per minute (ppm) printer, the document will require two minutes of printer time. The total time until the printer is available may then be calculated by summing the print times for each document in the printer queue. SPP **300** performs this calculation for every specific printer and designates the specific printer with the shortest wait time as the appropriate printer.

The printer with the shortest wait time may not necessarily be the printer with the fewest print jobs in the printer queue and SPP **300** will select a printer with more items in a wait queue and a shorter wait time over a printer with fewer items in the wait queue and a longer wait time.

For example, if a first printer is capable of printing at twenty ppm and has two separate forty-page documents in the wait queue, then the first printer will be available in four minutes. By contrast, if a second printer is capable of printing at ten ppm and has five separate two-page documents, then the second printer will be available in one minute. In the preceding example, the second printer is preferable over the first printer because the second printer has a shorter wait time. In an alternative embodiment, SPP **300** can factor the time required to print the current print job into the calculation, which would then produce the time required to print the current print job as opposed to the time until the printer is available. If all of the printers have the same printing speeds, then the assignment of print jobs to printers will not change by calculating the time required to print the current print job. However, if the printers have different print speeds, then the assignment of print jobs to the printers may change by calculating the time required to print the current print job. Recalling the two printer examples above, if the current print job is one hundred pages, then the current print job may be printed in nine minutes (four minutes waiting and five minutes printing) on the first printer. By contrast, the same one hundred page document would take eleven minutes to print (one minute waiting plus ten minutes printing) on the second printer, making the first printer the appropriate printer. In a second example, if the current document is only ten pages, then the document will take four and a half minutes to print on the first printer and two minutes to print on the second printer, making the second printer the appropriate printer.

SPP **300** may also determine the appropriate printers for a plurality of print jobs as is the case when the print job is separated into a plurality of print jobs. In this case, SPP **300** designates the printers with the shortest wait times as the appropriate printers. Alternatively, SPP **300** can designate the printers with the shortest print time as the appropriate printers. SPP

300 may also rank the printers based on the wait time for each printer or print time for each print job and assign the largest print job to the printer that will be available first or print the fastest, and continue this process until all the print jobs have been assigned to the printers. SPP **300** then sends the print job(s) to the appropriate printer(s) **318** (**316**). If the printed document pages are to be reassembled manually, then SPP **300** will print a control page before the print job on each specific printer. The control page informs the user of the location of the printers that printed the separated parts of the original document. The user can use the control page(s) as instructions for reassembling the document. If the printed document pages are to be assembled by an automated process, then the control pages may not be necessary. SPP **300** then ends (**320**).

Turning to FIG. 6, the logic of Color Printer Program (CPP) **400** is illustrated. CPP **400** is a methodology for printing the document pages that are stored in the color printer holding queue. CPP **400** starts (**402**) when requested by CP **200**. CPP **400** then accepts a user definition of a color printer page threshold (**404**). The color printer page threshold is the maximum number of pages to be printed as a single print job on any one printer. If the print job exceeds the color printer page threshold, then the print job will be separated into a plurality of smaller print jobs. The color printer page threshold can be stored in memory so that the user does not have to enter a new color printer page threshold upon every use of the present invention. Alternatively to accepting a user defined color printer page threshold, CPP **400** can automatically select a color printer page threshold by a method determined by persons of ordinary skill in the art.

Next, CPP **400** acquires the number of pages from the holding queue for the color printer (**406**). CPP **400** compiles these pages into a single print job for the color printer. CPP **400** then makes a determination whether the number of pages in the current print job is greater than the color printer page threshold (**408**). If the number of pages in the current print job is greater than

the color printer page threshold, then CPP **400** separates the print job (**410**) and returns to step **408**. In separating the print job, CPP **400** may divide the print job into two even-sized print jobs. Alternatively, CPP **400** may extract a series of print jobs each less than the color printer page threshold from the original print job until there are no print jobs exceeding the color printer page threshold. Persons of ordinary skill in the art are aware of other methods for separating a print job. If at step **408** CPP **400** determines that the number of pages is not greater than the color printer page threshold, then CPP **400** proceeds to step **412**.

At step **412**, CPP **400** determines the appropriate printer for the print job(s) (**412**). In order to determine the appropriate printer, CPP **400** analyzes the color print farm profile **414** obtained from memory. Print farm profile **414** may be the print farm profile for only the color printers or may be a print farm profile for all printers such as print farm profile **102** in FIG. 2. It is likely that there may be a plurality of color printers and that CPP **400** will have to choose the most appropriate printer(s) for the print job(s) from the available printers. CPP **400** determines the appropriate printer by analyzing the number and size of print jobs queued for each color printer. CPP **400** calculates the print time for each document in the print queue by dividing the size of each print job by the printer speed. For example, if a forty page document is printing on a twenty page per minute (ppm) printer, the document will require two minutes of printer time. The total time until the printer is available may then be calculated by summing the print times for each document in the printer queue. CPP **400** performs this calculation for every color printer and designates the color printer with the shortest wait time as the appropriate printer.

The printer with the shortest wait time may not necessarily be the printer with the fewest print jobs in the printer queue and CPP **400** will select a printer with more items in a wait queue and a shorter wait time over a printer with fewer items in the wait queue and a longer wait time.

For example, if a first printer is capable of printing at twenty ppm and has two separate forty-page documents in the wait queue, then the first printer will be available in four minutes. By contrast, if a second printer is capable of printing at ten ppm and has five separate two-page documents, then the second printer will be available in one minute. In the preceding example, the second printer is preferable over the first printer because the second printer has a shorter wait time. In an alternative embodiment, CPP **400** can factor the time required to print the current print job into the calculation, which would then produce the time required to print the current print job as opposed to the time until the printer is available. If all of the printers have the same printing speeds, then the assignment of print jobs to printers will not change by calculating the time required to print the current print job. However, if the printers have different print speeds, then the assignment of print jobs to the printers may change by calculating the time required to print the current print job. Recalling the two printer examples above, if the current print job is one hundred pages, then the current print job may be printed in nine minutes (four minutes waiting and five minutes printing) on the first printer. By contrast, the same one hundred page document would take eleven minutes to print (one minute waiting plus ten minutes printing) on the second printer, making the first printer the appropriate printer. In a second example, if the current document is only ten pages, then the document will take four and a half minutes to print on the first printer and two minutes to print on the second printer, making the second printer the appropriate printer.

CPP **400** may also determine the appropriate printers for a plurality of print jobs as is the case when the print job is separated into a plurality of print jobs. In this case, CPP **400** designates the printers with the shortest wait times as the appropriate printers. Alternatively, CPP **400** can designate the printers with the shortest print time as the appropriate printers. CPP

400 may also rank the printers based on the wait time for each printer or print time for each print job and assign the largest print job to the printer that will be available first or print the fastest, and continue this process until all the print jobs have been assigned to the printers. CPP **400** then sends the print job(s) to the appropriate printer(s) **418** (**416**). If the printed document pages are to be reassembled manually, then CPP **400** will print a control page before the print job on each color printer. The control page informs the user of the location of the printers that printed the separated parts of the original document. The user can use the control page(s) as instructions for reassembling the document. If the printed document pages are to be assembled by an automated process, then the control pages may not be necessary. CPP **400** then ends (**420**).

Turning to FIG. 7, the logic of Black/White Printer Program (B/WPP) **500** is illustrated. B/WPP **500** is a methodology for printing the document pages that are stored in the black/white printer holding queue. B/WPP **500** starts (**502**) when requested by CP **200**. B/WPP **500** then accepts a user definition of a black/white printer page threshold (**504**). The black/white printer page threshold is the maximum number of pages to be printed as a single print job on any one printer. If the print job exceeds the black/white printer page threshold, then the print job will be separated into a plurality of smaller print jobs. The black/white printer page threshold can be stored in memory so that the user does not have to enter a new black/white printer page threshold upon every use of the present invention. Alternatively to accepting a user defined black/white printer page threshold, B/WPP **500** can automatically select a black/white printer page threshold by a method determined by persons of ordinary skill in the art.

Next, B/WPP **500** acquires the number of pages from the holding queue for the black/white printer (**506**). B/WPP **500** compiles these pages into a single print job for the black/white printer. B/WPP **500** then makes a determination whether the number of pages in the

current print job is greater than the black/white printer page threshold (**508**). If the number of pages in the current print job is greater than the black/white printer page threshold, then B/WPP **500** separates the print job (**510**) and returns to step **508**. In separating the print job, B/WPP **500** may divide the print job into two even-sized print jobs. Alternatively, B/WPP **500** may extract a series of print jobs each less than the black/white printer page threshold from the original print job until there are no print jobs exceeding the black/white printer page threshold. Persons of ordinary skill in the art are aware of other methods for separating a print job. If at step **508** B/WPP **500** determines that the number of pages is not greater than the black/white printer page threshold, then B/WPP **500** proceeds to step **512**.

At step **512**, B/WPP **500** determines the appropriate printer for the print job(s) (**512**). In order to determine the appropriate printer, B/WPP **500** analyzes the black/white print farm profile **514** obtained from memory. Print farm profile **514** may be the print farm profile for only the black/white printers or may be a print farm profile for all printers such as print farm profile **102** in FIG. 2. It is likely that there may be a plurality of black/white printers and that B/WPP **500** will have to choose the most appropriate printer(s) for the print job(s) from the available printers. B/WPP **500** determines the appropriate printer by analyzing the number and size of print jobs queued for each black/white printer. B/WPP **500** calculates the print time for each document in the print queue by dividing the size of each print job by the printer speed. For example, if a forty page document is printing on a twenty page per minute (ppm) printer, the document will require two minutes of printer time. The total time until the printer is available may then be calculated by summing the print times for each document in the printer queue. B/WPP **500** performs this calculation for every black/white printer and designates the black/white printer with the shortest wait time as the appropriate printer.

The printer with the shortest wait time may not necessarily be the printer with the fewest print jobs in the printer queue and B/WPP **500** will select a printer with more items in a wait queue and a shorter wait time over a printer with fewer items in the wait queue and a longer wait time. For example, if a first printer is capable of printing at twenty ppm and has two separate forty-page documents in the wait queue, then the first printer will be available in four minutes. By contrast, if a second printer is capable of printing at ten ppm and has five separate two-page documents, then the second printer will be available in one minute. In the preceding example, the second printer is preferable over the first printer because the second printer has a shorter wait time. In an alternative embodiment, B/WPP **500** can factor the time required to print the current print job into the calculation, which would then produce the time required to print the current print job as opposed to the time until the printer is available. If all of the printers have the same printing speeds, then the assignment of print jobs to printers will not change by calculating the time required to print the current print job. However, if the printers have different print speeds, then the assignment of print jobs to the printers may change by calculating the time required to print the current print job. Recalling the two printer examples above, if the current print job is one hundred pages, then the current print job may be printed in nine minutes (four minutes waiting and five minutes printing) on the first printer. By contrast, the same one hundred page document would take eleven minutes to print (one minute waiting plus ten minutes printing) on the second printer, making the first printer the appropriate printer. In a second example, if the current document is only ten pages, then the document will take four and a half minutes to print on the first printer and two minutes to print on the second printer, making the second printer the appropriate printer.

B/WPP **500** may also determine the appropriate printers for a plurality of print jobs as is the case when the print job is separated into a plurality of print jobs. In this case, B/WPP **500** designates the printers with the shortest wait times as the appropriate printers. Alternatively, B/WPP **500** can designate the printers with the shortest print time as the appropriate printers. B/WPP **500** may also rank the printers based on the wait time for each printer or print time for each print job and assign the largest print job to the printer that will be available first or print the fastest, and continue this process until all the print jobs have been assigned to the printers. B/WPP **500** then sends the print job(s) to the appropriate printer(s) **518** (**516**). If the printed document pages are to be reassembled manually, then B/WPP **500** will print a control page before the print job on each black/white printer. The control page informs the user of the location of the printers that printed the separated parts of the original document. The user can use the control page(s) as instructions for reassembling the document. If the printed document pages are to be assembled by an automated process, then the control pages may not be necessary. B/WPP **500** then ends (**520**).

Turning to FIG. 8, the process of printing a document utilizing the present invention is illustrated. A user has indicated a desire to print document **702** by clicking the print button or some similar action. As indicated in box **704**, the pages of document **702** require a printer with company letterhead, a color printer, a photo-quality printer, and a black/white printer. The document is sent to the print manger of the present invention **706** which may contain CP **200**, SPP **300**, CPP **400**, and/or B/WPP **500**. The print manager separates the documents into components that require a printer containing company letterhead **708**, color printers **710** and **712**, photo printer **714**, and black/white printers **716**, **718**, **720**, and **722**. The print manager may decide to send pages 17-19 of the document to color printer **712** instead of color printer **710** due

to a long wait time on color printer **710**. The print manager may also decide to separate pages 20-78 of the document and send pages 20-50 to black/white printer **718** and pages 51-78 to black/white printer **720**. When the pages have printed on the various printers, then the document is reassembled in a reassembly process **724** to produce a finished document **726**.

With respect to the above description, it is to be realized that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed readily apparent and obvious to one of ordinary skill in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present invention. The novel spirit of the present invention is still embodied by reordering or deleting some of the steps contained in this disclosure. The spirit of the invention is not meant to be limited in any way except by proper construction of the following claims.